**Natural Resources Conservation Service**
**Conservation Practice Standard**

# COMPOSTING FACILITY
# (No.)
# CODE 317

## DEFINITION

A facility for the biological stabilization of waste organic material.

## PURPOSE

To treat waste organic material biologically by producing a humus-like material that can be recycled as a soil amendment and fertilizer substitute or otherwise utilized in compliance with all laws, rules, and regulations. Waste organic material for composting may include livestock and poultry manure, dead animal carcasses, and food processing wastes where food is processed as part of normal farming operation. The scope of dead animal carcasses is limited to normal mortality rates, it is not intended for catastrophic losses.

## CONDITIONS WHERE PRACTICE APPLIES

This practice applies where: (1) waste organic material is generated by agricultural production or processing; (2) composting is needed to manage the waste organic material properly; and (3) an overall waste management system has been planned that accounts for the end use of the composted material.

## PLANNING CONSIDERATIONS

Manure and dead animal carcass are the most common materials composted in agricultural operations. Composting methods and equipment are usually geared toward one or the other. All types of manure can be composted while dead animal carcass composting is usually limited to poultry or swine and cattle nursery stock due to animal carcass size practical constraints.

Methods of composting covered in this standard are:

1. Windrows
2. Static Pile
3. In-Vessel
4. Compost Bin

Manure is typically composted using windrows, static pile, and in-vessel methods. Dead animal carcasses are typically composted using in-vessel and compost bin methods.

**Windrows** are more suited to large volumes of organic material that are managed by power equipment used to turn the composting material periodically. Periodic turning re-aerates the windrows.

Organic material in **static piles** is initially mixed to a homogeneous condition and not turned again throughout the composting process. Static pile material must have the proper moisture content and bulk density to facilitate air movement throughout the pile. Forced air might be necessary to facilitate the composting process.

**In-vessel** composting in a totally enclosed structure is carried out on a blended organic material under conditions where temperature and air flow are strictly controlled. Vessels usually have an agitating device to ensure proper mixing. Vessel dimensions must be consistent with equipment to be used for management of compost.

**Compost bins** are primarily used for dead animal carcass composting. Carcass composting is a two stage process. Carcasses, liter and a carbon source (usually straw) are initially layered in a bin. The primary stage is the composting that takes place in this initial bin. The secondary stage is the composting that takes place after the pile is transferred into secondary bins or a larger storage area.

**Process.** Composting is accomplished by mixing an energy source (carbonaceous material) with a nutrient source (nitrogenous material) in a prescribed manner and ratio to meet aerobic microbial metabolic requirements. The process is carried out under specific moisture and temperature conditions until the desired amount of composting is achieved. Correct proportions of the various

compost ingredients are essential to minimize odors and to avoid attracting flies, rodents, and other small animals.

**Carbon Source.** A dependable source of carbonaceous material must be available. This material is added to the manure or carcasses to achieve the required high carbon to nitrogen ratio (C:N). Wood chips, sawdust, peanut hulls, straw, corn cobs, bark, peat moss, and well bedded horse manure are good sources of carbon.

**Moisture Control.** Large amounts of water evaporate during the composting process because operating temperatures drive off water. It is important to provide the recommended initial moisture content to promote efficient composting and a desired end moisture content. Excess moisture can result in anaerobic conditions, retarding the compost process and creating odors.

**Odor.** Odor can be minimized by keeping the moisture content below the recommended initial 60 percent and avoiding low initial C:N ratios. Odors from dead animal carcass composting can also be minimized by maintaining the recommended thickness of compost media over the carcasses. Locate composting operations where movement of any odors toward neighbors will be minimized. Buffer areas, vegetative screens, and natural landscape features can help minimize the effects of odors.

**Equipment Needs.** Appropriate equipment must be available for initial mixing, turning, and hauling composted material and carbonaceous material. Appropriate long stem thermometers should be available for managing the composting material.

**Bulking Materials**. Bulking materials may be added to enhance air flow within the composting material. Piles that are too compact will inhibit the composting process. The carbonaceous material can be considered as a bulking agent. Where it is desirable to salvage carbonaceous material, provisions for removing the material, such as screening, must be made.

**Management.** Composting operations require close management. Management capabilities of the operator and availability of labor should be assessed as part of the planning and implementing process.

**Economics.** Benefits associated with the ultimate use of the composed material should be compared to the capitol expenditure and operating costs of the composting operations. In addition to cost return, benefits can include environmental protection, improved handling, disposal of dead poultry and other farm animal carcass, odor control, and reduced need for storage volume.

## DESIGN CRITERIA

Design guidance that may be used in the design of compost facilities can be found in:

1. Agricultural Waste Management Field Handbook, NRCS.

2. Livestock Waste Facilities Handbook, Midwest Plan Service.

3. On-Farm Composting Handbook, Northeast Regional Agricultural Engineering Service (NRAES-54).

**Environmental Considerations.**

**Soils.** Composting facilities in which the composting is done directly against the existing soil surface shall be located on soils having slow to moderate permeability to minimize seepage of dissolved substances into the soil profile and movement toward ground water. Composting shall not be done directly on hydrologic group "A" soils. Evaluate site paving needs in terms of effects of equipment operation on traffic ability and soil compaction.

When composting is done directly against soil, a three foot separation distance shall exist between the soil surface and the seasonal high water table.

Composting sites on soil shall be rotated yearly to allow plant uptake of nutrients and minerals leached into the soil from the manure stacks. When not composting, the site shall be vegetated to allow the uptake of these excess nutrients and minerals. The minimum length of time for the site to remain vegetated is dependent on the crop used. This time can range from one growing season for crops with high nutrient uptake and short establishment periods to multiple seasons for vegetation requiring longer establishment periods.

**Runoff**. Divert surface runoff from outside drainage areas around the compost facility and utilize or dispose of it properly. Properly manage movement of organic material, soluble substance, and substances attached to solids carried by runoff. Locate windrow and static pile compost facilities at least 300 ft. from any surface waters.

**Carbon-Nitrogen Ratio.** Calculate the amounts of the various ingredients to establish the desired carbon nitrogen ratio (C:N) of the mix to be composed. The C:N should be

between 20:1 and 30:1. Use the higher range of C:N for organic materials that decompose at a high rate (or are highly unstable) with associated high odor production.

**Facility Size.** Manure composting facilities must be sized according to the amount of manure produced, the amount of carbon source needed to achieve the required C:N ratio, and the estimated number of days required to achieve the desired degree of composting.

**Moisture.** The moisture content of the blended material at the beginning of the composting process should be close to but not greater than 60 percent (wet weight basis). Water used for moisture control must be free of deleterious substances.

**Pile Configuration.** Compost piles for windrowed and static piles should be triangular to parabolic in cross-sectional form with a base width to height ratio of about 2 to 1.

Increased surface area favorably affects evaporation and natural aeration and increases the area exposed to infiltration from precipitation in uncovered stacks. Aligning piles north to south and maintaining moderate side slopes maximizes solar warming. Windrows should be aligned to avoid accumulation of precipitation.

**Dead Animal Carcass Composting Bins.**

Composting facilities for the purpose of processing animal carcasses are to include a primary composting unit into which alternate layers of low moisture content manure (usually poultry manure), carbon source material (straw is common), and dead animal carcasses are placed. A secondary composting unit is also required to complete the composting process. This secondary unit may consist of either additional bins or a larger storage area.

The size of the composter units shall be based on the operations animal mortality rates. A safety factor of 2.5 shall be used to determine the actual size to accommodate mortalities during periods of heat stress.

Dead animal carcass composting bins shall be designed to facilitate transfer of compost material from the primary stage to the secondary stage. The primary stage will require multiple bins to properly load, monitor, and turn the compost. The dimensions of the facility shall be dependent on the reach of the loading and unloading equipment and the size of this equipment. The height of the bins shall not exceed six feet. The minimum bin width should be one foot wider than the equipment used to load and unload the compost material.

All bins and areas for storing composting materials shall be covered by a roofed structure to keep out precipitation. The bins and storage areas shall have concrete floors. Loading and unloading areas shall be roofed or shall have a concrete or gravel floor.

**Storage.** Provide properly designed storage facilities sized for the appropriate storage period. Protect compost material from the weather by roofs or other suitable covers. Structures must meet the requirements of Conservation Practice Standard 313, Waste Storage Facility.

**OPERATION AND MAINTENANCE**

**Composting Period.** The time needed for completion of the process varies with the material. The process must continue until the material reaches a stability level at which it can be safely stored without creating undesirable odors and poor handling features. Acceptable stability occurs when microbial activity diminishes to a low level. Visual inspection and temperature measurements will provide needed evaluation of compost status.

**Temperature.** Temperatures should be maintained between 130oF and 150oF early in the compost process. Temperatures should be kept below 150oF during this period to prevent the die off of beneficial organisms before adequate stability has been achieved. During the remainder of the composting period temperatures should be kept below 165oF.

Pathogens are killed when temperatures of 131oF or greater are maintained for 3 days within vessels, bins or aerated static piles or for 15 days within windrows being turned at least 5 times. Most weed seeds are killed at 150oF to 160oF.

If temperature falls significantly during the composting period and odors develop, or if material does not reach operating temperature, investigate piles for moisture content, porosity, and thoroughness of mixing.

**Aeration.** Heat generated by the process causes piles to dehydrate. As the process proceeds, material consolidates, and the volume of voids through which air flows decreases. Materials selected for the composting mix should provide for adequate air movement throughout the composting process. Periodically turning the pile and maintaining proper moisture levels for windrows and static poultry piles will normally provide adequate aeration.

**Nutrients.** Keep compost well aerated to minimize nitrogen loss by denitrification. Keep pH at neutral or slightly lower to avoid nitrogen loss by ammonification. High amounts of available carbon will aid nitrogen immobilization. A low C:N ratio will cause a loss of nitrogen. Phosphorus losses will be minimized when the composting process is managed according to the requirements of this standard. Include compost nutrients in nutrient management plans and determine the effects of use and management of nutrients on the quality of surface water and groundwater as related to human and livestock consumption.

**Testing Needs.** Test compost material for carbon, nitrogen, moisture, and pH if compost fails to reach desired temperature or if odor problems develop. The finished compost material should be periodically tested for constituents that could cause plant phytotoxicity as the result of application to crops. Composted materials that are prepared for the retail market will require testing for labeling purposes.

## PLANS AND SPECIFICATIONS

Plans and specifications for organic composting facility shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. A written operation and maintenance plan shall be developed with full knowledge and input of the owner-operator and included with the documents provided to the owner-operator.